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Claims

[c1] 1. A method of manufacturing a contact, comprising the steps of:
providing a substrate having a first conductive layer and a dielectric layer thereon, wherein the dielectric layer has a contact opening that exposes a portion of the first conductive layer;
forming a conductive nano-particle layer on the exposed surface of the first conductive layer; and
forming a second conductive layer inside the contact opening to cover the conductive nano-particle layer.

[c2] 2. The method of claim 1, wherein the conductive nano-particle layer comprises a metallic nano-particle layer.

[c3] 3. The method of claim 1, wherein the conductive nano-particle layer comprises a silicon nano-particle layer.

[c4] 4. The method of claim 1, wherein the nano-particles inside the conductive nano-particle layer has an average size smaller than 100 nanometers.

[c5] 5. The method of claim 1, wherein after the step of forming the conductive nano-particle layer, furthermore comprises performing an annealing process.

[c6] 6. The method of claim 5, wherein the annealing process is performed at a temperature between about 50°C to 300°C.

[c7] 7. The method of claim 1, wherein the step of forming the nano-particle layer includes performing a charge adsorption process, comprising the steps of:
immersing the substrate with the contact opening already formed thereon in a solution, wherein the solution contains dispersed conductive nano-particles; and
passing a direct current into the solution so that the conductive nano-particles are adsorbed and adhered to the surface of the first conductive layer.

[c8] 8. The method of claim 7, wherein the solution furthermore comprises some surfactant.

[c9] 9. The method of claim 1, wherein the step of forming the nano-particle layer includes performing a charge deposition process, comprising the steps of:
forming a patterned photoresist layer over the dielectric layer that exposes the contact opening;
immersing the substrate structure into an electroplating solution, wherein the electroplating solution contains dispersed conductive nano-particles; and
performing an electroplating process using the substrate

as an anode and a metallic electrode as a cathode to form the conductive nano-particle layer on the surface of the first conductive layer.

[c10] 10. The method of claim 9, wherein the electroplating solution furthermore comprises some surfactant.

[c11] 11. The method of claim 1, wherein the step of forming the nano-particle layer includes performing a molecular self-assembly process, comprising the steps of:
immersing the substrate with a contact opening already formed thereon in a solution having self-assembly molecules so that the self-assembly molecules are adsorbed to the surface of the first conductive layer; and
immersing the substrate in another solution, wherein the solution contains dispersed conductive nano-particles so that the nano-particles are adsorbed towards the layer of self-assembly molecules on the first conductive layer to form the conductive nano-particle layer.

[c12] 12. The method of claim 11, wherein the solution furthermore comprises some surfactant.

[c13] 13. A semiconductor device structure, comprising:
a conductive layer formed on a substrate;
a dielectric layer formed on the conductive layer;
a contact formed in the dielectric layer, wherein the con-

tact and the conductive layer are electrically connected; and

a conductive nano-particle layer formed between the conductive layer and the contact.

[c14] 14. The semiconductor device structure of claim 13, wherein the conductive nano-particle layer comprises a metallic nano-particle layer.

[c15] 15. The semiconductor device structure of claim 13, wherein the conductive nano-particle layer comprises a silicon nano-particle layer.

[c16] 16. The semiconductor device structure of claim 13, wherein conductive nano-particles in the conductive nano-particle layer have an average size smaller than 100 nanometers.

[c17] 17. The semiconductor device structure of claim 13, wherein the conductive nano-particle layer comprises a nano-particle consolidated nano-particle film.

[c18] 18. The semiconductor device structure of claim 13, wherein material forming the conductive layer comprises aluminum.